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The New Method for Optical Channel Drop Filter with High Quality Factor Based on Triangular Photonic Crystal Design

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ABSTRACT
*We have designed a new type of optical channel drop filter (CDF) based on two dimensional triangular lattice photonic crystals. CDF operation is based on coupling to the photonic crystal waveguide. The proposed structure is optimized to work as a CDF for obtaining the CDF characteristics and band structure of the filter the finite difference time domain (FDTD) method and plane wave expansion (PWE) method are used respectively. Dropping efficiency at*1550nm *and quality factor (Q) of our proposed structure are 96.36 % and 282.7, respectively. The quantities of quality factor and transmission efficiency are suitable for optical applications.*

KEYWORDS*:* Channel drop filter, FDTD method, Photonic crystal, Wavelength.

1. INTRODUCTION

Photonics crystal, are nano-sized periodic structures and devices that control manipulate the flow of light that are either dielectric or metal - dielectric that will affect the direction of the electromagnetic wave, by creating allowed and forbidden energy bands. Basis of photonic crystals based on internal change in refractive index to more or less within a crystal [1].

By creating unrighteousness (point line) in a periodic structure may guide the light propagation through the optical forbidden band (PBG) is performed; This particular behavior leads to the detection of almost all types of Photonics crystal (PhC) is based on active and passive components. Structures based on Photonics crystals (PhCs) that enables researchers to design small-scale tools [2, 3, 4]. In recent years, much of the PhC are designed based on optical instruments, such as multiplexer[5], demultiplexer[6], dipole radiation separators [7], power separators [8], switches (9), the pass filters [11, 10], non-pass filters [12], oriented couple markers [13] and drop filter [drip] in the channel [14] is one of the key factors to select single or multiple wavelength channels of optical filters drop in the channel.

2. DESIGNING CDF

As shown in Figure 1 can be seen, the basic structure is used to design the filter is a two-dimensional hexagonal lattice 26 × 19 of silicon rods with failure coefficients $n_{Si} = 3.46$and with air field $n_{air} = 1$. In this study, the ratio of rod radius to the lattice constant (a) is approximately 0.2. The normalized frequency of the first photonic band gap is equal to$0.5548 \leq a/\lambda \leq 0.5930$, as shown in Fig (2 - b), which corresponds to 1.026 mm to 1.097 mm wavelength range. According to Fig (2 - b), the second photonic band gap is equal to $0.4403 \geq \frac{a}{\lambda} \geq 0.27285$, which corresponds to 1.383 mm to 2.231 mm wavelength range. In TE mode, photonic band is according to Fig (2 - a), which normalized frequency of the photonic band gap is equal $0.8584 \geq \frac{a}{\lambda} \geq 0.8215$, which corresponds to 0.7094 to 0.7413 micrometers wavelength range.

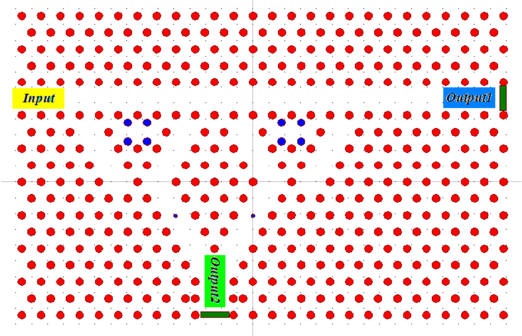

Fig. 1. The basic structure used to design the CDF

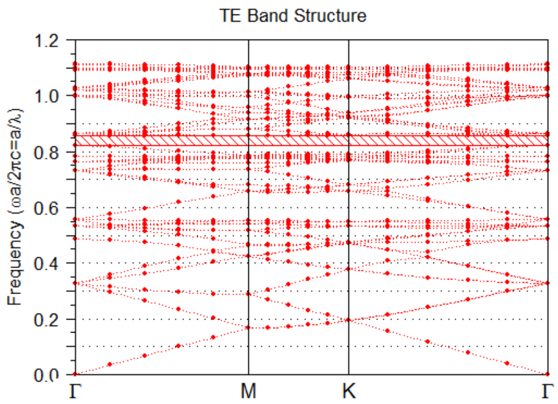

Fig.(2-a). Photonic band structure for TE mode

In this structure, forbidden band for normalized frequency is from 0.27285 a / λ to 0.4403 a /λ and normalized high frequency$0.5548\ a/\lambda$ to$0.593\ a/\lambda$ is for TM polarization.

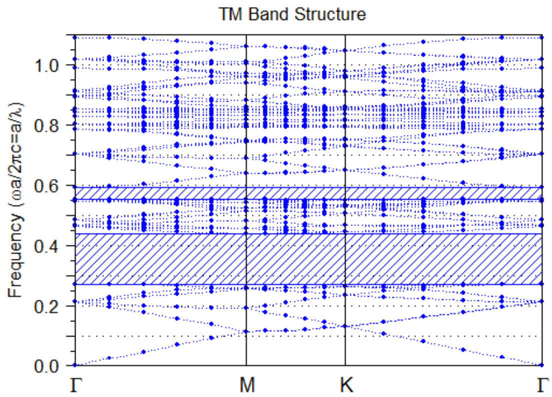

Fig.(2-b). Photonic band structure for TM mode

To improve the ability to spectral select and obtain very high efficiency of dropping, ten additional scatter rods were marked with a blue. These scatter exactly have the same as the reflection coefficients which other dielectric rod (insulating) in the PhCs structure [15, 16]. Radius of eight top distributors and two distributor players selected for best display, respectively 0.965r and 0.465r [4].

3. SIMULATION

A Gaussian pulse signal enters from the input section (Input), and its output is manifested by a Time monitor in outpu1 and output2. Normalized transmission spectra computed through fields Fourier transform (FFT); as well Fourier transform is given by the two-dimensional FDTD method. In Figure 3 the normalized transmission spectra for both outputs in parts of Output1 and Outpu2 in CDF are shown as blue and green lines, respectively. As can be seen, ability of spectral selection was improved considerably; which efficiency of 96.36% dropping can be obtained at 1550nm wavelength resonator; and quality factor of dropping is 272.8, also. Such values (Q) are sufficient for optical communication applications 1550nm and 1530nm.Figure (4 - a) and Figure (4 - b) draw model of intensify and non-intensify electric field,1530 nm and 1550nm respectively.

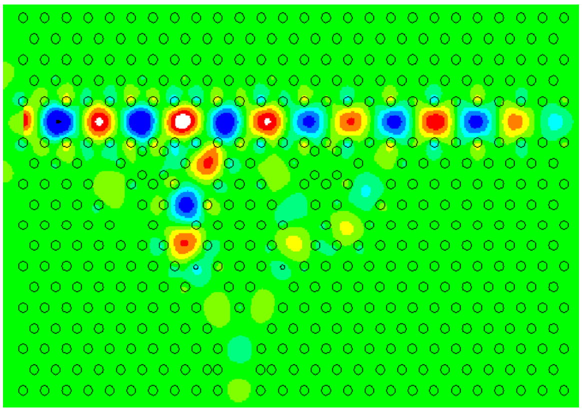

Fig.(4 - a)

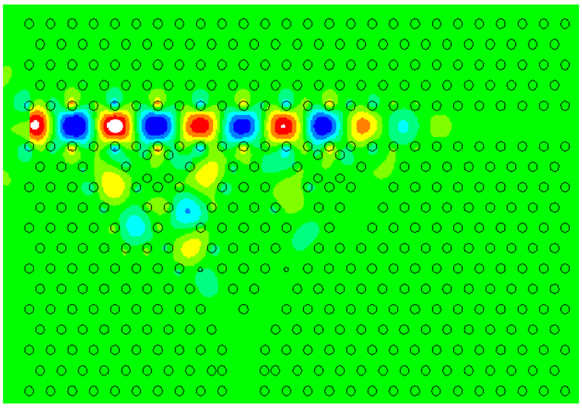

Fig.(4 -b)

Figure (4 - a) and Figure (4 - b). Draw model of intensify and non-intensify electric field, 1530 nm and 1550nm respectively.

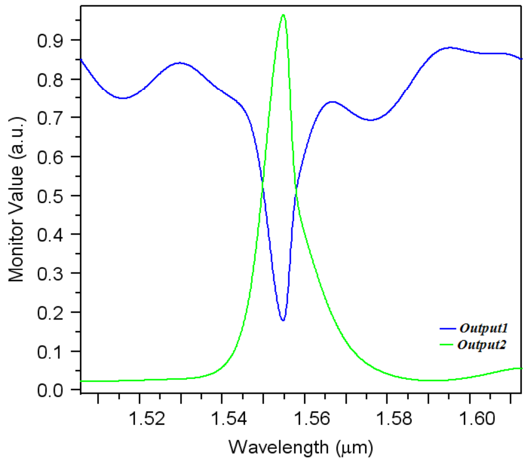

Fig. 3. The normalized transmission spectra for the two outputs in CDF

In intensify wavelength$(\lambda = 1550nm)$, the wave crossing electric field is located at output2, whereas, in non-intensify wavelength$(\lambda = 1530nm)$, signal will be sent straight to outpu1.

4. CONCLUSIONS

CDF two-dimensional photonic crystals presented and reviewed which can be obtained at λ = 1550nm by the FDTD method at the triangular silicon lattice rod with a drop efficiency of 96.36% and the quality factor of 272.8; this is an important advantage of the proposed CDF than reported CDFs in the field. In this paper it was shown that there is flexibility in optical crystal. Such structures provide virtual applications for optical integrated circuits based on PhCs and other nano-photonics structures.

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